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10 The present invention relates to cordless power tools, and more particularly, to cordless power tools having a battery release mechanism for releasably securing a battery to the power tool.

Cordless power tools are well-known and provide several advantages over traditional corded power tools. One of the advantages provided by cordless power tools is the mobility and/or portability when using the tool. For example, the operator of the cordless power tool can quickly and efficiently work over a larger area without having to continually adjust the power cord. Similarly, cordless power tools can be used in areas where electrical power is not available. Because of these advantages, the popularity of cordless power tools has increased among both professional and novice power tool users.

Despite these advantages, there are disadvantages associated with cordless power tools. One of the disadvantages associated with cordless power tools is the power limitations of the battery pack. Typically, most battery packs for cordless power tools can be operated between about 4 to 8 hours depending on the size of the battery and the amount of usage. Once the electrical charge in the battery is depleted, the operator typically is required to remove the battery pack from the power tool and recharge the battery using a battery charger.

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Many existing power tools include battery release mechanisms that allow the battery to be removed from the power tool and recharged. Existing battery release mechanisms include latching arrangements that releasably secure the battery pack to the power tool. For example, some existing release mechanisms include two push buttons
5 disposed on the side of the battery housing. In these arrangements, the battery pack extends upwards into the handle of the power tool. Thus, in order to remove the battery pack from the power tool, the user depresses both buttons and pulls downward on the battery pack to disengage the battery pack from the power tool. Other battery release mechanisms have a button disposed through the rear of the power tool. The user can
10 release the battery pack from the power tool by depressing or sliding the button such that the latching arrangement allows removal of the battery pack.

However, there are several shortcomings with existing battery release mechanisms. For example, release mechanisms that have two buttons typically require the operator to hold the power tool and depress both buttons while trying to remove the
15 battery pack from the power tool. Without depressing both release buttons, the battery pack is unable to be removed from the power tool. Moreover, release mechanisms having the release button disposed through the rear of the power tool typically require the operator to hold the tool differently from the way the power tool is held during operation in order to remove the battery. As a result, these battery release mechanisms
20 are often cumbersome and difficult to use.

Improvements in the mechanisms used to releasably secure battery packs to cordless power tools are sought.

SUMMARY OF THE DISCLOSURE

The present disclosure generally relates to cordless power tools. More
25 particularly, the present disclosure is directed towards cordless power tools having a battery release mechanism for releasably securing a battery to the power tool. The battery engages a closure member as the battery is forced into engagement with the tool from the rear.

One aspect of the invention relates to a cordless power tool having a
30 main body portion, a handle portion depending from the main body portion and a

mechanism for releasably securing a battery to the handle portion opposite the main body portion. The mechanism for releasably securing the battery to the handle portion includes a battery receiving portion integral with the handle portion and an attachment portion integral with the battery. The attachment portion is configured to engage the battery receiving portion. The mechanism also includes a closure member that is operable with and transversely disposed within the battery receiving portion. The closure member is configured to secure the battery within the battery receiving portion when the closure member is in a "lock" position. The closure member has a first end and a second end opposite the first end. The first end is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from the "lock" position to a "release" position. When the closure member is in the "release" position, the battery can be removed from the power tool.

In yet another aspect of the invention, the closure member also includes a locking finger integral with the second end of the closure member. The locking finger is configured to secure the battery within the battery receiving portion when the closure member is in the "lock" position. Furthermore, the battery receiving portion includes a first guide channel and a second guide channel. Similarly, the attachment portion includes a first guide rail and a second guide rail. The first and second guide rails are configured to interlock with the first and second guide channels.

In an alternative aspect of the invention, the mechanism for releasably securing a battery to a power tool includes a battery receiving portion integral with the power tool housing. The battery receiving portion includes a mounting surface for receiving the battery and an attachment portion integral with the battery. The attachment portion is configured to slidably engage the battery receiving portion. Furthermore, the mechanism for releasably securing the battery to the power tool also includes a closure member that is operable with and arranged substantially perpendicular to the battery receiving portion. The closure member is configured to secure the battery within the battery receiving portion when the closure member is in a "lock" position. Conversely, the closure member is configured to disengage the battery when the closure member is in a "release" position. In this aspect of the disclosure, the closure member includes a first end and a second end opposite the first end. The closure

member has an elongated body portion and a locking finger that is integral with and extends from the body portion substantially near the second end of the closure member. The locking finger is configured to secure the attachment portion to the power tool when the battery is positioned within the battery receiving portion.

5 In another aspect, the first end of the locking finger is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from the "lock" position to the "release" position. The battery receiving portion includes a first guide channel and a second guide channel. Similarly, the attachment portion includes a first guide rail and a second guide rail. The first and
10 second guide rails are configured to interlock with the first and second guide channels. The first guide rail has a first end for engaging the locking finger when the battery is moved in a first direction relative to the attachment portion. The first guide rail has a second end for engaging the locking finger when the battery is moved in a second direction relative to the attachment portion.

15 A method for releasably securing a battery to a power tool housing is also disclose. The method includes the steps of providing a power tool having a battery receiving portion integral with the power tool housing. The battery receiving portion is operable with a closure member that is transversely disposed within the battery receiving portion and configured to secure the battery within the battery receiving
20 portion. The closure member has a first end and a second end. The first end of the closure member is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from a "lock" position to a "release" position. On the battery, an attachment portion is provided that is integral with the battery and is further constructed to engage the battery receiving portion. The method
25 further includes the steps of aligning the attachment portion with the battery receiving portion and moving the battery in a first direction such that the attachment portion slidably engages the battery receiving portion and the closure member such that the closure member is urged into the "release" position. To releasably secure the battery to power tool, the battery is positioned within the battery receiving such that the closure
30 member returns to the "lock" position. Preferably, the attachment portion slidably engages the battery receiving portion from the rear of the power tool.

The above summary of the present invention is not intended to describe each illustrated embodiment or every implementation of the present invention. Other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of exemplary embodiments thereof, as
5 illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

10 FIG. 1 is a perspective view illustrating a power tool having a battery pack secured thereto according to the principles of the present disclosure;

FIG. 2 is a side-elevational view illustrating a first side of the power tool shown in FIG. 1;

15 FIG. 3 is a side-elevational view illustrating a second side of the power tool shown in FIG. 1 opposite the first side of the power tool shown in FIG. 2;

FIG. 4 is a side-elevational view illustrating the front of the power tool shown in FIGS. 1-3;

FIG. 5 is a side-elevational view illustrating the rear of the power tool shown in FIGS. 1-4;

20 FIG. 6 is a side-elevational view illustrating the battery receiving portion from the rear of the power tool shown in FIG. 5;

FIG. 7A is a plan view of the bottom of the power tool shown in FIG. 1 - 5 illustrating a battery release mechanism in a "lock" position;

25 FIG. 7B is a plan view of the bottom of the power tool shown in FIG. 1 illustrating the battery release mechanism in a "release" position;

FIG. 8 is a plan view of a closure member for use with the battery release mechanism of the present disclosure;

FIG. 9 is a side-elevational view of the closure member shown in FIG. 8;

FIG. 10 is a plan view of the top of a battery pack illustrating the battering receiving portion according to the principles of the present disclosure;

FIG. 11 is a side-elevational view of the battery pack shown in FIG. 10;

FIG. 12 is an exploded, side-elevational view of the power tool shown in
5 FIGS. 1-5 illustrating a battery in slidable engagement with the power tool; and

FIGS. 13A, 13B, and 13C are cross-sectional views of the power tool of
FIG. 3 taken along line 13-13 illustrating engagement of the battery of FIGS. 10 and 11
with the power tool of FIGS. 1-5.

While the invention is amenable to various modifications and alternative
10 forms, specifics thereof have been shown by way of example in the drawings and will
be described in detail. It should be understood, however, that the intention is not to
limit the invention to the particular embodiments described. On the contrary, the
intention is to cover all modifications, equivalents, and alternatives falling within the
spirit and scope of the invention as defined by the appended claims.

15 DETAILED DESCRIPTION

The present disclosure generally relates to cordless power tools. More
particularly, the present disclosure is directed towards cordless power tools having a
battery release mechanism for releasably securing a battery to the power tool. While the
present invention is not so limited, a more detailed understanding of the present
20 invention will be gained through a discussion of the drawings in connection with the
examples provided below.

Referring now to FIG. 1, there is illustrated a cordless electric power tool
100. By way of illustration, the power tool 100 shown in FIG. 1 is an electric power
drill/driver. However, it should be understood that the present invention is generally
25 applicable to a variety of power tools, including cordless circular saws, cordless
reciprocating saws, planars, flashlights, as well as other cordless tools having a
rechargeable battery pack secured thereto.

The power tool 100 has a housing 102 that is preferably molded from a
suitable plastic material, such as polyethylene, polypropylene, or polyurethane. In a
30 preferred embodiment, the power tool housing 102 is injection molded having two

halves portions **102A**, **102B**. The two halve portions **102A**, **102B** are secured together in a conventional manner using mechanical fasteners (not shown), such as screws. The tool housing **102** includes a generally tubular and elongated main body portion **103**. An electric motor (not shown) is disposed within the body portion **103**. The electric motor is electrically coupled to a battery pack **108** that provides the electrical energy to power the electric motor. Furthermore, the electric motor is mechanically coupled to an output shaft **105** that can be configured to operate with various tool accessories. For example, the output shaft **105** is a conventional drill chuck that can be configured to operate with tool accessories, such as, drill bits, drivers, or other accessories.

The tool housing **102** also includes a handle portion **104** that extends downwardly from the main body portion **103**. By “downwardly,” it is meant that in the orientation of the power tool **100** shown in FIG. 1, the handle portion **104** extends below the main body portion **103** of the power tool **100**. The handle portion **104** is configured and arranged to allow a user to easily grip and maneuver the power tool **100** during operation. As shown in FIGS. 2 – 5, the handle portion **104** includes a first side region **111A**, a second side region **111B** opposite the first side region **111A**. Additionally, the handle portion **104** includes a front region **113A** connecting the first and second side regions **111A**, **111B** along the front of the power tool, and a rear region **113B** connecting the first and second side regions **111A**, **111B** along the rear of the power tool **100**. In the embodiment shown in FIGS. 2 – 5, the first side region **111A** is the “right-hand” side of the handle portion **104** and the second side region **111B** is the “left-hand” side of the handle portion **104**.

The power tool housing **102** also defines a trigger receiving portion **109** disposed between the main body portion **103** and the handle portion **104**. More particularly, the trigger receiving portion **109** is disposed between the main body portion **103** and the front region **113A**. The trigger receiving portion **109** is sized and configured to allow the operator to engage a trigger **107** disposed through the trigger receiving portion **109**. Moreover, the trigger receiving portion **109** defines a ridge **112** that separates the trigger receiving portion **109** from the handle portion **104**. The ridge **112** assists the operator in properly aligning his hand on the handle portion **104** when

operating the power tool **100**. For example, when the operator is gripping the power tool **100**, the operator typically uses his trigger finger (eg. the operator's forefinger) to actuate the trigger **107**. While the operator's trigger finger is positioned over the trigger receiving portion **109**, the ridge **112** ensures that the operator's other fingers are
5 positioned below the trigger **107** and are, therefore, unable to actuate the trigger **107**.

Referring again to FIG. 1, the power tool **100** also includes a support portion **106** that is integral with the handle portion **104**. The support portion **106** is generally flat and elongated and extends in a direction substantially parallel to the elongated main body portion **103**. The support portion **106** stabilizes the power tool
10 **100** when resting on a flat surface in an upright position as shown in FIG. 1. As will be described in greater detail below, a battery pack **108** is releasably secured to the support portion **106** of the power tool **100**. In one embodiment, the battery **108** can be released from the power tool **100** by depressing the button **110** which is disposed through a side of the handle portion **104**.

Referring now to FIG. 6, a side elevational view illustrating the rear of the power tool **100** is shown. As can be seen, the support portion **106** depends from and is integral with the handle portion **104**. The support portion **106** includes a battery receiving portion **112**. The battery receiving portion **112** is sized and configured to slidably receive the battery **108** (FIG. 1) through the opening **114**. The battery receiving
20 portion **112** is capable of accommodating any size battery **108** that is capable of operating the cordless power tool **100**. For example, the battery **108** can be a 12 volt, 14.4 volt or a 19.2 volt battery or any other size battery capable of operating the cordless power tool **100**. The battery receiving portion **112** includes a first guide channel **116** and a second guide channel **119**. The first guide channel **116** is generally "L-shaped" and includes an upright member **117** depending from the mounting surface **115**. A
25 flange member **118** extends laterally from and substantially perpendicular to the upright member **117**. Similarly, the second guide member **119** is also generally "L-shaped" and includes an upright member **120** depending from and substantially perpendicular to the mounting surface **115**. A flange member **121** extends laterally from and substantially
30 perpendicular to the upright member **120**. Additionally, electrical terminals or contacts

122 depend from the mounting surface 115 and are disposed within the battery receiving portion 112. Preferably, the electrical terminals or contacts 122 are substantially centered between the first and second guide channels 116, 119. The electrical terminals 122 are situated to engage the battery terminals 162 integral with the battery 108

5 discussed below in connection with FIGS. 10 and 11.

Referring now to FIG. 7A, a bottom plan view of the power tool 100 is shown illustrating the battery release mechanism according to the principles of the present disclosure. As can be seen, the first guide channel 116 is substantially parallel to the second guide channel 119. Further, the first and second guide channels 116, 119 are situated along the length of the mounting surface 115 and are spaced apart a lateral distance. As discussed above, the first and second guide channels 116, 119 are constructed and arranged to receive the battery 108 (FIG. 1).

The battery release mechanism includes a generally elongated closure member 130 that is situated within the battery receiving portion 112 substantially perpendicular to the first and second guide channels 116, 119. As shown in FIGS. 8 and 9, the closure member 130 has a first end 132 and a second end 134. The first end 132 is disposed through a side wall of the power tool housing 100 and defines a push button 110 that allows a user to selectively move the closure member 130 from a "lock" position to a "release" position. In one embodiment, the push button 110 is disposed through the first side region 111A of the handle portion 104. Alternatively, the push button 110 can be disposed through the second side region 111B of the handle portion 104. Thus, an operator can easily and efficiently release the battery 108 from the power tool 100 by depressing a single button 110 disposed through a side region of the power tool 100.

Additionally, as shown in FIG. 9, the elongated closure member 130 also includes a locking finger 136 at or substantially near the second end 134. The locking finger 136 is constructed and arranged to selectively obstruct the first guide channel 116. As shown in FIG. 8, the locking finger 136 includes an angled or chamfered surface 138 and a rear edge surface 139 that converge at the tip 137. In one embodiment, the locking finger 136 obstructs at least a portion of the first guide rail 116

when the closure member 130 is disposed within the battery receiving portion 112 and in the "lock" position. By "obstruct," it is meant that the tip 137 of the locking finger 136 extends beyond the upright member 117 of the first guide rail 116. In the embodiment shown in FIG. 6, the tip 137 of the locking finger 136 is substantially coplanar with the tip 118A of the laterally extending flange member 118. Conversely, when the closure member 130 is in the "release" position as shown in FIG. 7B, the locking finger 136 no longer obstructs the first guide channel 116. Instead, the tip 137 of the locking finger 136 is substantially coplanar with the upright member 117. In the embodiment shown in FIG. 7B, the tip 137 of the locking finger 136 is substantially coplanar with the upright member 117.

A post 135 extends from a lower portion 133 of the closure member 130 as shown in FIGS. 7A, 7B, and 8. The post 135 is sized and configured to receive a spring 125, such as a helical coil compression spring. The spring 125 biases the closure member 130 in the "lock" position. For example, when the closure member 130 is disposed within the battery receiving portion 112, the spring 125 biases the closure member 130 into the "lock" position such that the locking finger 136 obstructs at least a portion of the first guide channel 116 as discussed above. Conversely, when the push button 110 is depressed, the spring 125 is compressed as the closure member 130 is moved from the "lock" position to the "release" position.

As discussed above, the battery receiving portion 112 is constructed and arranged to receive and secure the battery 108 within the battery receiving portion 112. Referring now to FIGS. 10 and 11, the battery 108 includes a main body portion 150. The main body portion 150 has a flat bottom surface 150A that allows the power tool 100 to remain in an upright position as shown in FIG. 1 when the battery 108 is secured to the power tool 100.

An attachment portion 151 opposite the bottom surface 150A is provided to engage with the battery receiving portion 112 of the power tool 100. In a preferred embodiment, the attachment portion 151 is substantially centered on the attachment surface 158. The attachment portion 151 includes a first guide rail 152 and a second guide rail 155. The first guide rail 152 is a generally "L-shaped" and includes an

upright member **153** extending upwards and substantially perpendicular from the attachment surface **158** and opposite the bottom surface **150A**. A flange member **154** extends laterally from and substantially perpendicular to the upright member **153**. The second guide rail **155** is also generally “L-shaped” and also includes an upright member

5 **156** extending upwards and substantially perpendicular from the attachment surface **158** and opposite the bottom surface **150A**. A flange member **157** extends laterally from and substantially perpendicular to the upright member **156**. A rear edge **164** extends between and connects the first and second guide rails **152, 155**.

The first and second guide rails **152, 155** are constructed and arranged to

10 engage and interlock with the first and second guide channels **116, 119**, respectively. By “interlock,” it is meant that the first and second guide rails **152, 155** cooperate with the first and second guide channels **116, 119** to allow the battery **108** to slidably engage with the power tool **100**. To facilitate this, the flange member **154** of the first guide rail **152** has a chamfered or beveled leading edge **154A**. Similarly, the flange member **157**

15 of the second guide rail **155** has a chamfered or beveled leading edge **157A**. The chamfered or beveled leading edges **154A, 157A** allows easier alignment and interlocking between the first and second guide rails **152, 155** and the first and second guide channels **116, 119**.

The battery terminals **162** are disposed within the attachment portion **151**

20 of the battery **108**. The battery terminals **162** are electrically coupled to the battery cells **159** disposed within the main body portion **150** of the battery **108**. The battery terminals **162** are constructed and arranged to engage the battery contacts **122** disposed within the battery receiving portion **112**. Accordingly, electrical communication is provided between the battery terminals **162** and the battery contacts **122** when the

25 battery **108** is releasably secured to the power tool **100** according to the present disclosure. Furthermore, the battery **108** also includes a sealing member **166** that seals the opening **114** once the battery **108** is releasably secured to the power tool **100**.

In operation, the battery **108** can be releasably secured to the power tool **100** by bringing the attachment portion **151** of the battery **108** into engagement with the

30 battery receiving portion **112** of the power tool **100**. Preferably, as shown in FIG. 12 the

battery 108 is brought into engagement with the power tool 100 from the rear. This is accomplished by first aligning the attachment portion 151 with the opening 114 of the battery receiving portion 112. As shown in FIG. 13A, after aligning the attachment portion 151 with the battery receiving portion 112, the battery 108 can be slid into the tool housing 102 such that the first guide rail 152 engages the first guide channel 116 and the second guide rail 155 engages the second guide channel 119. For example, FIG. 13A shows the battery receiving portion 112 and the attachment portion 154A in initial engagement. Thus, the leading edge 154A is in physical engagement with the locking finger 136 that obstructs at least a portion of the first guide channel 116.

As the attachment portion 151 is slid into engagement with the battery receiving portion 112, the first and second guide rails 152, 155 are allowed to interlock with the first and second guide channels 116, 119. As discussed above, the closure member 130 is biased into the "lock" position such that the locking finger 136 obstructs at least a portion of the first guide channel 116. However, as shown in FIG. 13B, as the battery 108 is slidably moved into engagement with the battery receiving portion 112, the first guide rail 152 engages the closure member 130 and urges the closure member 130 into the "release" position. For example, the first guide rail 152 urges the locking finger 136 out of the first guide channel 116 such that the tip 137 is substantially coplanar with the upright member 117 of the first guide channel 116. In a preferred embodiment, the flange member 153 of the first guide rail 152 has a chamfered leading edge 153A that engages the angled or chamfered surface 138 of the locking finger 136 as the first guide rail 152 slidably engages the first guide channel 116. Accordingly, the resistance of the locking finger 136 to be moved from the guide channel 116 is reduced. The battery 108 is moved further into the battery receiving portion 112 until the rear edge 164 of the attachment portion 151 moves beyond the rear edge 139 of the locking finger 136 as shown in FIG. 13C. In this position, the first guide rail 152 no longer urges the locking finger out of the first guide channel 116 and therefore, the closure member 130 is allowed to return to the "lock" position. In this position, the battery 108 is secured to the power tool 100.

An operator can release the battery **108** from the power tool **100** by depressing the push button **110** and urging the battery **108** in a direction towards the rear of the power tool **100**. Preferably, the push button **110** is disposed through the side of the power tool housing **102** and can be depressed by the operator using the same hand that urges the battery **108** away from the power tool **100**. By depressing the push button **110**, the closure member **130** is urged from the "lock" position to the "release" position. In the "release" position, the locking finger **136** of the closure member **130** no longer obstructs the first guide channel **116**. Thus, the rear edge **164** of the attachment portion **151** no longer prevented from movement by the rear edge **139** of the locking finger **136**. As a result, the battery **108** can be easily removed from the battery receiving portion **112** of the power tool **100** by depressing a single button **110** disposed through a side region of the power tool **100** and pulling the battery **108** from the power tool **100**.

The operator can maintain a firm grip on the handle portion **104** with a first hand while gripping the battery **108** and depressing the push button **110** with a second hand. Preferably, the first hand of the operator grips the handle portion **104** of the power tool **100** similar to the way the power tool **100** is held during operation. A second hand of the operator grips the battery while depressing the button **110** and pulling the battery **108** from the power tool **100**. Alternatively, the operator can depress the button **110** with a finger of the first hand holding the handle portion **104** while pulling the battery **108** from the power tool **100**. In either case, the operator can easily and efficiently remove the battery **108** from the power tool **100**.

The above specification and embodiments are believed to provide a complete description of the manufacturer and use of particular embodiments of the invention. Many embodiments of the invention can be made without departing from the spirit and scope of the invention, which is limited by the attached claims.